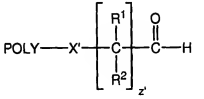
WHAT IS CLAIMED IS:

1. A water-soluble polymer having the structure:



I

wherein:

POLY is a water-soluble polymer segment;

X' is a linker moiety;

z' is an integer from 1 to about 21;

R^1, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl;

R^2, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl,

and further wherein the following apply:

-when POLY is linear:

(a) the total number of carbonyls present in said polymer is 0 or 2 or greater except when X' comprises one or more contiguous (-CH_2CH_2O-) segments,

(b) and further wherein X' is oxygen or comprises at least one (-CH_2CH_2O-) segment and z' is from 2 to 12, then at least one of R^1 or R^2 in at least one occurrence is an organic radical as defined above or said polymer is

heterobifunctional, where POLY comprises a reactive group at one terminus that is not hydroxy, and

-when POLY is branched:

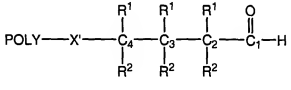
(c) either (i) at least one of R^1 or R^2 in at least one occurrence is an organic radical as defined above or (ii) X' includes $-(CH_2CH_2O)_b-$ where b is from 1 to about 20 in the instance where POLY comprises a lysine residue,

(d) and further wherein said POLY has 2 polymer arms, then neither polymer arm comprises oxygen as the only heteroatom in the instance where POLY comprises "C-H" as a branch point.

2. The polymer of claim 1, wherein z' ranges from 2 to 21.

3. The polymer of claim 1, wherein z' ranges from 3 to 12.

4. The polymer of claim 1, having the structure:



I-A

wherein POLY, X', each R^1, each R^2 and R^3 are as previously defined.

5. The polymer of claim 4, wherein the R^1 attached to C_2 is alkyl, and all other R^1 and R^2 variables are H.

6. The polymer of claim 5, wherein the R^1 attached to C_2 is lower alkyl.

7. The polymer of claim 6, wherein the R^1 attached to C_2 is selected from the group consisting of methyl, ethyl and propyl.

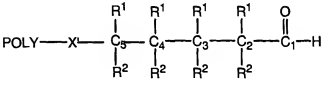
8. The polymer of claim 4, wherein the R^1 attached to C_3 is alkyl, and all other R^1 and R^2 variables are H.

9. The polymer of claim 8, wherein the R^1 attached to C_3 is lower alkyl.

10. The polymer of claim 4, wherein the R^1 attached to C_4 is alkyl, and all other R^1 and R^2 variables are H.

11. The polymer of claim 10, wherein the R^1 attached to C_4 is lower alkyl.

12. The polymer of claim 1, having the structure:



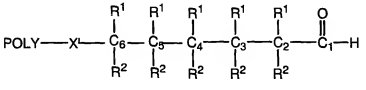
I-B

wherein POLY, X', and each R^1 and each R^2 are as previously defined.

13. The polymer of claim 12, wherein the R^1 attached to C_2 is alkyl, and all other R^1 and R^2 variables are H.

14. The polymer of claim 12, wherein either the R^1 attached to C_3 or C_4 is alkyl, and all other R^1 and R^2 variables are H.

15. The polymer of claim 1, having the structure:



I-C

wherein POLY, X', and each R^1 and each R^2 are as previously defined.

16. The polymer of claim 15, wherein the R^1 attached to C_2 is alkyl, and all other R^1 and R^2 variables are H.

17. The polymer of claim 15, wherein one of the R^1 variables attached to C_3 or C_4 or C_5 is alkyl, and all other R1 and R2 variables are H.

18. The polymer of claim 1, wherein X' comprises a moiety corresponding to the structure:

$$-(CH_2)_c-D_e-(CH_2)_f- \quad \text{or} \quad -(CH_2)_p-M_r-C(O)-K_s-(CH_2)_q-$$

wherein:

c is zero to 8,
D is O, NH, or S,
e is 0, 1
f is zero to 8,
p is zero to 8,
M is –NH, O
K is NH, O
q is from zero to 8, and
r and s are each independently 0, 1

19. The polymer of claim 1, wherein X' includes a moiety corresponding to the structure $-(CH_2CH_2O)_b-$ or $-(CH_2CH_2NH)_g-$, and b and g are each independently 1 to 20.

20. The polymer of claim 19, wherein b and g are each independently 1 to 10.

21. The polymer of claim 20, wherein b and g are each independently 1 to 6.

22. The polymer of claim 18, wherein X' comprises a moiety corresponding to the structure:

$$-(CH_2)_c\text{-}D_e\text{-}(CH_2)_f\text{-}P- \quad \text{or} \quad -(CH_2)_p\text{-}M_r\text{-}C(O)\text{-}K_s\text{-}(CH_2)_q\text{-}T-$$

wherein:

P and T are each independently $-(CH_2CH_2O)_b-$ or $-(CH_2CH_2NH)_g$,

b and g are each independently 1 to 20,

and the remaining variables are as defined in claim 18.

23. The polymer of claim 1, wherein said X' comprises $-C(O)NH-(CH_2)_{1-6}NH-C(O)-$ or $-NHC(O)NH-(CH_2)_{1-6}NH-C(O)-$.

24. The polymer of claim 1, wherein POLY is selected from the group consisting of poly(alkylene oxide), poly(vinyl pyrrolidone), poly(vinyl alcohol), polyoxazoline, poly(acryloylmorpholine), and poly(oxyethylated polyol).

25. The polymer of claim 1, wherein POLY is a poly(alkylene oxide).

26. The polymer of claim 25, wherein POLY is a poly(ethylene glycol).

27. The polymer of claim 26, wherein the poly(ethylene glycol) is terminally capped with an end-capping moiety.

28. The polymer of claim 27, wherein the end-capping moiety is independently selected from the group consisting alkoxy, substituted alkoxy, alkenyloxy, substituted alkenyloxy, alkynyloxy, substituted alkynyloxy, aryloxy, substituted aryloxy.

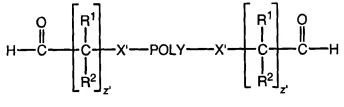
29. The polymer of claim 28, wherein the end-capping moiety is selected from the group consisting of methoxy, ethoxy, and benzyloxy.

30. The polymer of claim 26, wherein the poly(ethylene glycol) has a nominal average molecular mass of from about 100 daltons to about 100,000 daltons.

31. The polymer of claim 26, wherein the poly(ethylene glycol) has a nominal average molecular mass of from about 1,000 daltons to about 50,000 daltons.

32. The polymer of claim 26, wherein the poly(ethylene glycol) has a nominal average molecular mass of from about 2,000 daltons to about 30,000 daltons.

33. The polymer of claim 1, comprising the structure:



II

wherein POLY, each X', each (z'), and each R^1 and each R^2 are as previously defined.

34. The polymer of claim 33, wherein said POLY is linear and the polymer is homobifunctional.

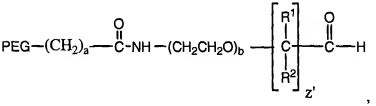
35. The polymer of claim 26, wherein said poly(ethylene glycol) has a structure selected from the group consisting of linear, branched and forked.

36. The polymer of claim 26, wherein said poly(ethylene glycol) comprises the structure:

$$Z\text{-}(CH_2CH_2O)_n\text{-} \quad \text{or} \quad Z\text{-}(CH_2CH_2O)_n\text{-}CH_2CH_2\text{-},$$

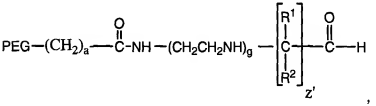
where n is from about 10 to about 4000, and Z comprises a moiety selected from the group consisting of hydroxy, amino, ester, carbonate, aldehyde, alkenyl, acrylate, methacrylate, acrylamide, sulfone, thiol, carboxylic acid, isocyanate, isothiocyanate, hydrazide, maleimide, vinylsulfone, dithiopyridine, vinylpyridine, iodoacetamide, alkoxy, benzyloxy, silane, lipid, phospholipid, biotin, and fluorescein.

37. The polymer of claim 1, having a structure selected from the group consisting of:



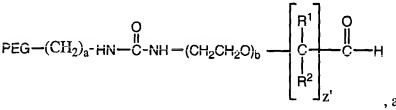
,

III-A



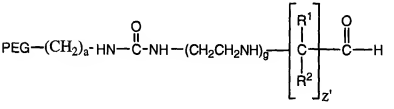
,

IV-A



, and

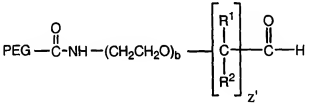
III-C



IV-C

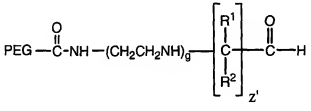
wherein PEG is poly(ethylene glycol), b and g are each independently 0 to 20, a is 0 to 6, and the remaining variables are as defined in claim 1.

38. The polymer of claim 37, having the structure:



III-B

or



IV-B

wherein the variables are as defined as in claim 37.

39. The polymer of claim 37, wherein PEG has a structure selected from the group consisting of linear, branched, and forked.

40. The polymer of claim 37, wherein b and g each independently are from 1-8.

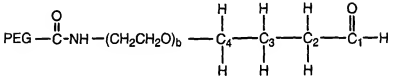
41. The polymer of claim 37, wherein b and g each independently are from 1 to 6.

42. The polymer of claim 37, wherein z' is from 2 to 6.

43. The polymer of claim 37, wherein z' is 3.

44. The polymer of claim 37, wherein a is 0 or 1.

45. The polymer of claim 37, having the structure:

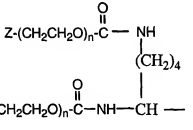


III-D

46. The polymer of claim 45, wherein "PEG" is a poly(ethylene glycol) having a structure corresponding to:

$Z\text{-}(CH_2CH_2O)_n\text{-}$,

or

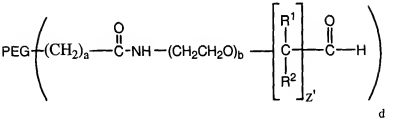


V

wherein n in each occurrence is independently from about 10 to about 4000, and Z comprises a moiety selected from the group consisting of hydroxy, ester, carbonate, aldehyde, alkenyl, acrylate, methacrylate, acrylamide, sulfone, thiol, carboxylic acid, isocyanate, isothiocyanate, maleimide, vinylsulfone, dithiopyridine, vinylpyridine, iodoacetamide, alkoxy, benzyloxy, silane, phospholipid, biotin, and fluorescein.

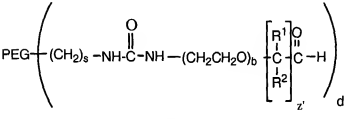
47. The polymer of claim 46, wherein Z is alkoxy, and n in each occurrence is the same and ranges from about 100 -600.

48. The polymer of claim 1, having the structure:



VI-A

or



VI-B

wherein:

PEG is poly(ethylene glycol),

b is 0 to 20,

s is 0 to 6,

d is 1, 2 or 3,

and the remaining variables are as defined in claim 1.

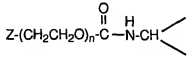
49. The polymer of claim 48, wherein PEG is linear or branched.

50. The polymer of claim 48, wherein R^1 and R^2 in each occurrence are H.

51. The polymer of claim 48, wherein z' ranges from 3 to 12.

52. The polymer of claim 48, wherein z' is 3.

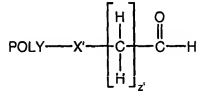
53. The polymer of claim 48, wherein d is 2 and PEG corresponds to the structure:



wherein n is from about 10 to about 4000, Z comprises a moiety selected from the group consisting of hydroxy, ester, carbonate, aldehyde, alkenyl, acrylate, methacrylate, acrylamide, sulfone, thiol, carboxylic acid, isocyanate, isothiocyanate, maleimide, hydrazide, vinylsulfone, dithiopyridine, vinylpyridine, iodoacetamide, alkoxy, benzyloxy, silane, lipid, phospholipid, biotin, and fluorescein, and the remaining variables are as defined in claim 48.

54. The polymer of claim 53, wherein Z is alkoxy or benzyloxy, n ranges from about 200 to about 1500, and b is from 1 to 8.

55. A composition comprising a water-soluble polymer having the structure:



VII

wherein:

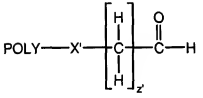
POLY is a water-soluble polymer segment;

X' is a linker moiety, and

z' is an integer from 1 to about 21,

and said composition is absent detectable amounts of iodine-containing species or retro-Michael type reaction products.

56. A composition comprising a water-soluble polymer having the structure:



VII

wherein:

POLY is a linear, terminally end-capped water-soluble polymer segment;

X' is a linker moiety,

z' is an integer from 1 to about 21,

and said composition is absent detectable amounts of dialdehyde polymer derivative.

57. The composition of claim 55 or 56, wherein z' ranges from 2 to 21.

58. The composition of claim 55 or 56, wherein z' ranges from 3 to 12.

59. The composition of claim 55 or 56, wherein z' ranges from 3 to 8.

60. The composition of claim 55 or 56, wherein POLY is selected from the group consisting of a poly(alkylene oxide), poly(vinyl pyrrolidone), poly(vinyl alcohol), polyoxazoline, poly(acryloylmorpholine), and poly(oxyethylated polyol).

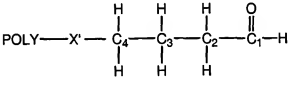
61. The composition of claim 55, wherein POLY is a poly(alkylene oxide).

62. The composition of claim 61, wherein POLY is a poly(ethylene glycol).

63. The composition of claim 56, wherein POLY is a poly(alkylene oxide).

64. The composition of claim 63, wherein POLY is a poly(ethylene glycol).

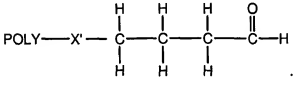
65. The composition of claim 55, wherein said polymer comprises the structure:



VII-A

66. The composition of claim 65, wherein POLY is a poly(ethylene glycol).

67. The composition of claim 56, wherein said polymer comprises the structure:



68. The composition of claim 67, wherein POLY is a poly(ethylene glycol).

69. The composition of claim 65, wherein X' comprises a moiety corresponding to the structure:

$-(CH_2)_c-D_e-(CH_2)_f-$ or $-(CH_2)_p-M_r-C(O)-K_s-(CH_2)_q-$

wherein:

c is zero to 8,

D is O, NH, or S,

e is 0, 1

f is zero to 8,

p is zero to 8,

M is –NH, O

K is NH, O

q is from zero to 8, and

r and s are each independently 0, 1.

70. The composition of claim 65, wherein X' is hydrolytically stable.

71. The composition of claim 65, wherein POLY corresponds to the structure:

$$Z\text{-}(CH_2CH_2O)_n\text{-}CH_2CH_2 \text{ —} ,$$

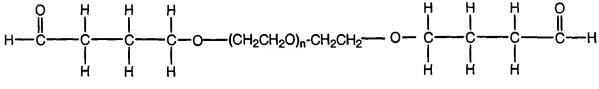
X' is O,

n is from about 10 to about 4000, and

Z comprises a moiety selected from the group consisting of hydroxy, ester, carbonate, aldehyde, alkenyl, acrylate, methacrylate, acrylamide, sulfone, thiol, carboxylic acid, isocyanate, isothiocyanate, maleimide, vinylsulfone, dithiopyridine, vinylpyridine, iodoacetamide, alkoxy, benzyloxy, silane, phospholipid, biotin, and fluorescein.

72. The composition of claim 71, wherein Z is C1 to C20 alkoxy or benzyloxy.

73. The composition of claim 71, wherein said polymer comprises the structure:



VIII

where n is as defined in claim 71.

74. The composition of claim 72, wherein Z is methoxy.

75. The composition of claim 66, wherein said poly(ethylene glycol) has a structure selected from the group consisting of linear, branched and forked.

76. The composition of claim 66, wherein X' includes an oligomeric moiety corresponding to the structure $-(CH_2CH_2O)_b-$ or $-(CH_2CH_2NH)_g-$, and b and g are each independently 1 to 20.

77. The composition of claim 76, wherein b and g are each independently 1 to 10.

78. The composition of claim 20, wherein b and g are each independently 1 to 6.

79. The composition of claim 76, wherein said oligomeric moiety is covalently attached to the C4 methylene.

80. The composition of claim 79, wherein said X' further comprises an amide or a urethane.

81. The composition of claim 80, wherein X' comprises a moiety selected from the group consisting of $-C(O)NH-(CH_2CH_2O)_b-$, $-OC(O)NH-(CH_2CH_2O)_b-$, $-C(O)NH-(CH_2CH_2NH)_g-$, $-OC(O)NH-(CH_2CH_2NH)_g-$, and b and g are as defined in claim 76 above.

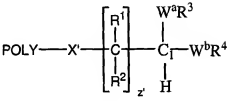
82. A hydrate or acetal form of the water-soluble polymer of claim 1.

83. A hydrate or acetal form of the water-soluble polymer of claim 55.

84. The acetal of claim 82, wherein said acetal is selected from the group consisting of dimethyl acetal, diethyl acetal, di-isopropyl acetal, dibenzyl acetal, 2,2,2-trichloroethyl acetal, bis(2-nitrobenzyl) acetal, S,S'-dimethyl acetal, and S,S'-diethyl acetal.

85. A water soluble polymer of claim 1, protected as a dioxolane.

86. A polymer comprising the structure:



IX

wherein:

POLY is a water-soluble polymer segment;

X' is a linker moiety

z' is an integer from 1 to about 21;

R^1, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl;

R^2, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl,

W^a and W^b are each independently O or S, and

R^3 and R^4 are each independently H, or an organic radical selected from the group consisting of methyl, ethyl, isopropyl, benzyl, 1,1,1-trichoroethyl, and nitrobenzyl, or when taken together, are $-(CH_2)_2-$ or $-(CH_2)_3-$, forming a 5 or 6 membered ring when considered together with W^a, C_1, and W^b.

87. The polymer of claim 83, wherein the following apply:

-when POLY is linear:

(a) then the total number of carbonyls present in said polymer is 0 or 2 or greater except when X' comprises one or more contiguous ($-CH_2CH_2O-$) segments,

(b) and further wherein X' is oxygen or comprises at least one ($-CH_2CH_2O-$) segment and z' is from 2 to 12, then at least one of R^1 or R^2 in at least

one occurrence is an organic radical as defined above or said polymer is heterobifunctional, where POLY comprises a reactive group at one terminus that is not hydroxy, and

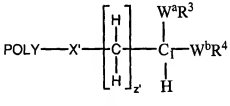
-when POLY is branched:,

(c) then either at least one of R^1 or R^2 in at least one occurrence is an organic radical as defined above or X' includes $-(CH_2CH_2O)_b-$ where b is from 1 to about 20,

and further in the instance where POLY comprises a lysine residue,

(d) and has 2 polymer arms, then neither polymer arm comprises oxygen as the only heteroatom in the instance where POLY comprises "C-H" as a branch point.

88. A water-soluble polymer having the structure:



IX-A

wherein:

POLY is a water-soluble polymer segment;

X' is a linker moiety,

z' is an integer from 1 to about 21,

W^a and W^b are each independently O or S, and

R^3 and R^4 are each independently H, or an organic radical selected from the group consisting of methyl, ethyl, isopropyl, benzyl, 1,1,1-trichoroethyl, and nitrobenzyl, or when taken together, are $-(CH_2)_2-$ or $-(CH_2)_3-$, forming a 5 or 6 membered ring when considered together with W^a, C_1, and W^b.

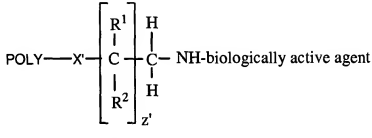
89. The polymer of claim 88, wherein said polymer is absent detectable amounts of iodine-containing species or retro-Michael-type reaction products.

90. A conjugate formed by reaction of a biologically active agent with the polymer of claim 1.

91. A conjugate formed by reaction of a biologically active agent with the composition of claim 55.

92. A conjugate formed by reaction of a biologically active agent with the composition of claim 56.

93. A conjugate comprising the following structure:



X

wherein:

POLY is a water-soluble polymer segment;

X' is a linker moiety;

z' is an integer from 1 to about 21;

R^1, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl;

R^2, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl,

-"NH-biologically active agent" represents a biologically active agent comprising an amino group,

and further wherein the following apply:

-when POLY is linear:

(a) the total number of carbonyls present in said polymer is 0 or 2 or greater except when X' comprises one or more contiguous (-CH_2CH_2O-) segments,

(b) and X' is oxygen or comprises at least one (-CH_2CH_2O-) segment and z' is from 2 to 12, then at least one of R^1 or R^2 in at least one occurrence is an organic radical as defined above or said polymer is heterobifunctional where POLY comprises a reactive group at one terminus that is not hydroxy, and

-when POLY is branched:

(c) then either at least one of R^1 or R^2 in at least one occurrence is an organic radical as defined above or X' includes -$(CH_2CH_2O)_b$- where b is from 1 to about 20,

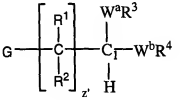
and further in the instance where POLY comprises a lysine residue,

(d) and has 2 polymer arms, then neither polymer arm comprises oxygen as the only heteroatom in the instance where POLY comprises "C-H" as a branch point.

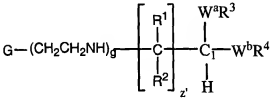
94. A hydrogel formed using the water soluble polymer of claim 1.

95. A hydrogel formed using the composition of claim 55.

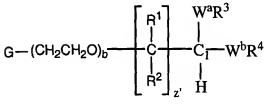
96. A protected aldehyde comprising a structure selected from the group consisting of :



XI-A



XI-B



XI-C

wherein :

z' is an integer from 1 to about 21;

R^1, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl;

R^2, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl,

W^a and W^b are each independently O or S, and

R^3 and R^4 are each independently H, or an organic radical selected from the group consisting of methyl, ethyl, isopropyl, benzyl, 1,1,1-trichoroethyl, and nitrobenzyl, or when taken together, are $-(CH_2)_2-$ or $-(CH_2)_3-$, forming a 5 or 6 membered ring when considered together with W^a, C_1, and W^b.

b and g are each independently 1 to 20, and

G is a functional group.

97. The protected aldehyde of claim 96, wherein G is a leaving group.

98. The protected aldehyde of claim 97, wherein G is selected from the group consisting of Cl, Br, para-tolylsulfonate ester, methylsulfonyl ester, trifluorosulfonylester, and trifluoroethylsulfonyl ester.

99. The protected aldehyde of claim 96, wherein G is a functional group selected from the group consisting of -OH, $-NH_2$, -SH, and protected forms thereof.

100. The protected aldehyde of claim 96, wherein z' is ranges from 2 to 12.

101. The protected aldehyde of claim 96, wherein R^1 in any one position selected from the group consisting of C_2 (α), C_3 (β), and C_4 (γ), is alkyl, and all other R^1 and R^2 variables are H.

102. The protected aldehyde of claim 96, wherein b and g are each independently 1 to 8.

103. The protected aldehyde of claim 96, wherein b and g are each independently 1 to 6.

104. The protected aldehyde of claim 96, wherein b and g each equal 4.

105. A method of forming a water-soluble polymer alkanal, optionally in protected form, said method comprising the steps of:

reacting a water soluble polymer comprising at least one reactive group, Y, with a protected alkanal reagent comprising from about 2 to 20 carbon atoms and a reactive group, K, suitable for displacement by or alternatively, reaction with Y, under conditions effective to form a water soluble polymer alkanal in protected form.

106. The method of claim 105, wherein said reacting step is carried out in an organic solvent.

107. The method of claim 106, wherein said organic solvent is selected from the group consisting of toluene, chloroform, methylene chloride, acetonitrile, acetone, dioxane, methanol, and ethanol.

108. The method of claim 105, wherein said reacting is carried out under an inert atmosphere.

109. The method of claim 105, wherein said reacting is carried out at temperatures ranging from about 20°C to about 150°C.

110. The method of claim 105, further comprising hydrolyzing said water soluble polymer alkanal in protected form under acidic conditions to thereby form the corresponding water soluble polymer alkanal.

111. The method of claim 110, wherein said hydrolyzing is carried out in aqueous solvent.

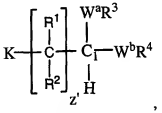
112. The method of claim 111, wherein said alkanal reagent comprises 4 or more carbon atoms.

113. The method of claim 112, wherein said hydrolyzing is carried out at a pH of no lower than about 3.

114. The method of claim 105, wherein said alkanal reagent is protected as an acetal.

115. The method of claim 114, wherein said acetal is selected from the group consisting of dimethyl acetal, diethyl acetal, di-isopropyl acetal, dibenzyl acetal, 2,2,2-trichloroethyl acetal, bis(2-nitrobenzyl) acetal, S,S'-dimethyl acetal, and S,S'-diethyl acetal, cyclic acetals and cyclic thioacetals.

116. The method of claim 105, wherein said water soluble polymer comprises the structure, POLY-Y, and said protected alkanal reagent comprises the structure,



XI-D

wherein:

z' is an integer from 1 to about 21;

R^1, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl;

R^2, in each occurrence, is independently H or an organic radical selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, and substituted aryl,

W^a and W^b are each independently O or S, and

R^3 and R^4 are each independently H or an organic radical selected from the group consisting of methyl, ethyl, isopropyl, benzyl, 1,1,1-trichoroethyl, and nitrobenzyl,

or when taken together, are $-(CH_2)_2-$ or $-(CH_2)_3-$, forming a 5 or 6 membered ring when considered together with W^a, C_1, and W^b.

117. The method of claim 116, wherein POLY is selected from the group consisting of a poly(alkylene oxide), poly(vinyl pyrrolidone), poly(vinyl alcohol), polyoxazoline, poly(acryloylmorpholine), and poly(oxyethylated polyol).

118. The method of claim 117, wherein POLY is a poly(ethylene glycol).

119. The method of claim 118, wherein the poly(ethylene glycol) is terminally capped with an end-capping moiety.

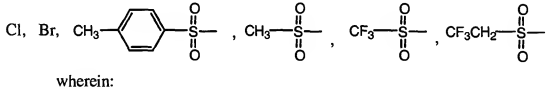
120. The method of claim 119, wherein the end-capping moiety is selected from the group consisting alkoxy, substituted alkoxy, alkenyloxy, substituted alkenyloxy, alkynyloxy, substituted alkynyloxy, aryloxy, substituted aryloxy.

121. The method of claim 120, wherein the end-capping moiety is selected from the group consisting of methoxy, ethoxy, and benzyloxy.

122. The method of claim 119, wherein:

POLY-Y comprises the structure $Z-(CH_2CH_2O)_nH$, wherein n is from about 10 to about 4000, and Z is selected from the group consisting of $-OCH_3$, $-OCH_2CH_3$, $-OCH_2(C_6H_5)$,

and K is selected from the group consisting of:



wherein:

R^1 and R^2 are each independently H or lower alkyl, and

W^a and W^b are each O.

123. The method of claim 122, wherein z' ranges from 4 to about 12.

124. The method of claim 122, wherein z' ranges from 4 to about 8.

125. The method of claim 122, wherein R^1 and R^2 are both H in each occurrence.

126. The method of claim 122, wherein said a water soluble polymer alkanal in protected form is formed in greater than about 85% yield.

127. The method of claim 126, wherein said water soluble polymer alkanal in protected form is formed in greater than about 95% yield.

128. The method of claim 122, further comprising hydrolyzing said water soluble polymer alkanal in protected form under acidic conditions to thereby form the corresponding water soluble polymer alkanal in a reaction mixture.

129. The method of claim 128, wherein said hydrolyzing is carried out in aqueous solvent.

130. The method of claim 126, further comprising the step of isolating said alkanal from the reaction mixture.

131. The method of claim 130, wherein said isolating comprises:
raising the pH of the reaction mixture to from about 6.0 to 7.5,
extracting the alkanal into an organic solvent, and
removing the solvent.

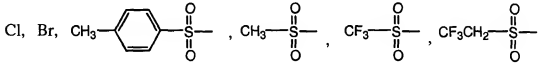
132. The method of claim 131, wherein said isolated alkanal is absent detectable amounts of $Z\text{-}(CH_2CH_2O)_nH$ and retro-Michael type reaction products.

133. The method of claim 132, wherein said isolated alkanal has a purity of at least about 95%, based upon polymeric contaminants.

134. The method of claim 118, wherein:

POLY-Y comprises the structure $HO\text{-}(CH_2CH_2O)_nH$, wherein n is from about 10 to about 4000,

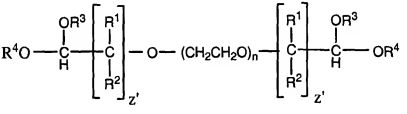
and K is selected from the group consisting of:



wherein:

R^1 and R^2 are each independently H or lower alkyl, and

W^a and W^b are each O, to form an alkanal in protected form having the structure:

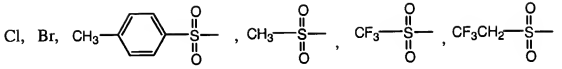


XII

135. The method of claim 118, wherein:

POLY-Y comprises the structure $Z\text{-}(CH_2CH_2O)_nH$, wherein n is from about 10 to about 4000, and Z is protected hydroxyl,

and K is selected from the group consisting of:

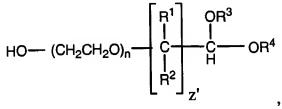


wherein:

R^1 and R^2 are each independently H or lower alkyl, and

W^a and W^b are each O.

136. The method of claim 135, further comprising after said reacting step, deprotecting said protected hydroxyl to form



, and

XI-E

converting said terminal –OH on the poly(ethylene glycol) to a functional group other than hydroxyl.

137. The method of claim 136, wherein said functional group is selected from the group consisting of amino, ester, carbonate, aldehyde, alkenyl, acrylate, methacrylate, acrylamide, sulfone, thiol, carboxylic acid, isocyanate, isothiocyanate, maleimide, vinylsulfone, dithiopyridine, vinylpyridine, iodoacetamide, and silane.

138. The method of claim 137, wherein said functional group is selected from the group consisting of N-hydroxysuccinimidyl ester, benzotriazolyl carbonate, amine, protected amine, vinylsulfone, and maleimide.

139. The method of claim 136, further comprising the step of hydrolyzing said water soluble polymer alkanal in protected form under acidic conditions to thereby form the corresponding water soluble polymer alkanal.

140. The method of claim 118, wherein Y in said POLY-Y is an ionizable group or is a derivative of an ionizable group.

141. The method of claim 140, wherein Y is selected from the group consisting of carboxylic acid, active ester,and amine.

142. The method of claim 141, wherein said POLY-Y has been chromatographically purified prior to use in said reacting step.

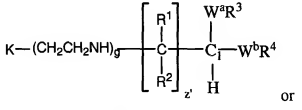
143. The method of claim 142, wherein said POLY-Y has been purified by ion exchange chromatography.

144. The method of claim 142, wherein said POLY-Y for use in said reacting step is essentially absent detectable amounts of polymeric impurities.

145. The method of claim 142, wherein said POLY-Y for use in said reacting step is end-capped, and is essentially absent detectable amounts of PEG-diol or difunctional PEG impurities.

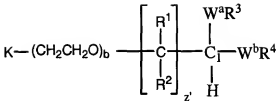
146. The method of claim 142, wherein said poly(ethylene glycol) has a structure selected from the group consisting of linear, branched, and forked.

147. The method of claim 142, wherein said alkanal reagent comprises the structure:



or

XI-F



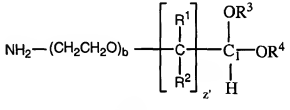
XI-G

wherein g and b each independently range from about 1 to about 20.

148. The method of claim 147, wherein R^1 and R^2 are each independently H or lower alkyl, and W^a and W^b are each O.

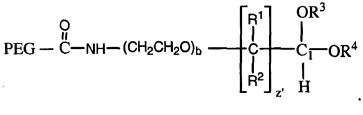
149. The method of claim 147, wherein K is a moiety comprising a group selected from the group consisting of carboxylic acid, active ester, amine, active carbonate, and isocyanate.

150. The method of claim 148, wherein said alkanal reagent comprises the structure:



XI-H

and the product of said reacting step comprises a structure:



IX-B

151. The method of claim 147, further comprising the step of hydrolyzing said water soluble polymer alkanal in protected form under acidic conditions to form the corresponding water soluble polymer alkanal in greater than 50% yield.

152. The method of claim 151, wherein said hydrolyzing step is effective to form said water soluble polymer alkanal in greater than about 90% yield.

153. The method of claim 110, further comprising the step of conjugating said water soluble polymer alkanal with a biologically active agent comprising an amino group.

154. The method of claim 147, wherein said reacting step is carried out at ambient temperature.